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(54) **MONITORING SYSTEM**

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G06T 7/62 (2017.01)

G06T 7/254 (2017.01)

(52) **U.S. Cl.**

CPC **G08B 13/19613** (2013.01); **G06T 7/254** (2017.01); **G06T 7/62** (2017.01); **G08B 13/19691** (2013.01); **G06T 2207/10016** (2013.01); **G06T 2207/30196** (2013.01); **G06T 2207/30232** (2013.01)

(58) **Field of Classification Search**

CPC G08B 13/19613; G08B 13/19691; G08B 13/194; G06T 7/62; G06T 7/254; G06T 2207/10016; G06T 2207/30196; G06T 2207/30232

See application file for complete search history.

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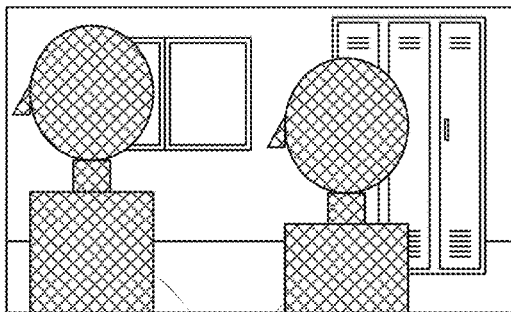
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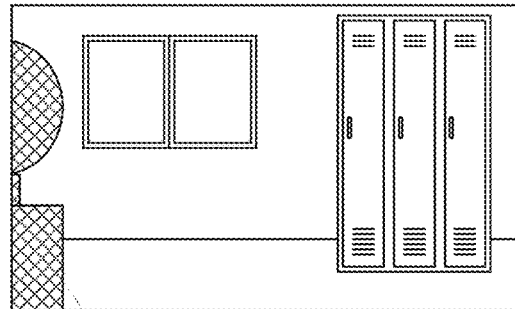
(57) **ABSTRACT**

A monitoring system includes: a camera, a storage section, and a control unit. The camera photographs an object. The storage section stores a first photographed image photographed by the camera and a second photographed image photographed by the camera at a same photographing place of a photographing place of the first photographed image after the photographing of the first photographed image. The control unit includes a processor and, through execution of a control program by the processor, functions as an obstacle determination section and a control section. The obstacle determination section calculates a difference between the first photographed image and the second photographed image and determines, based on the difference, whether or not an obstacle is present in a photographing range of the camera. The control section performs, upon determination by the obstacle determination section that the obstacle is present, processing of reporting results of the determination.

6 Claims, 5 Drawing Sheets



Δ G21



Δ G22

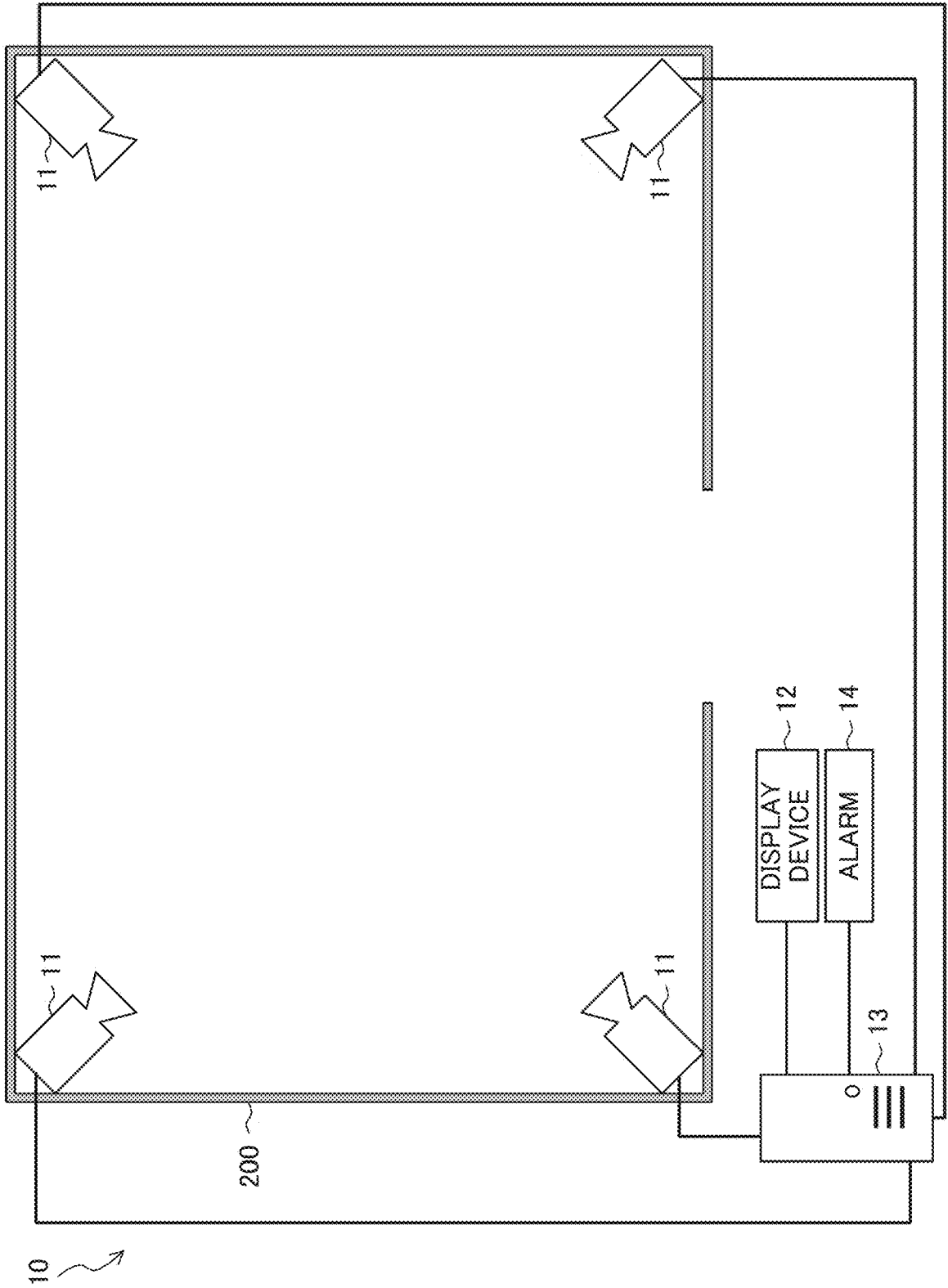


Fig. 1

Fig.2

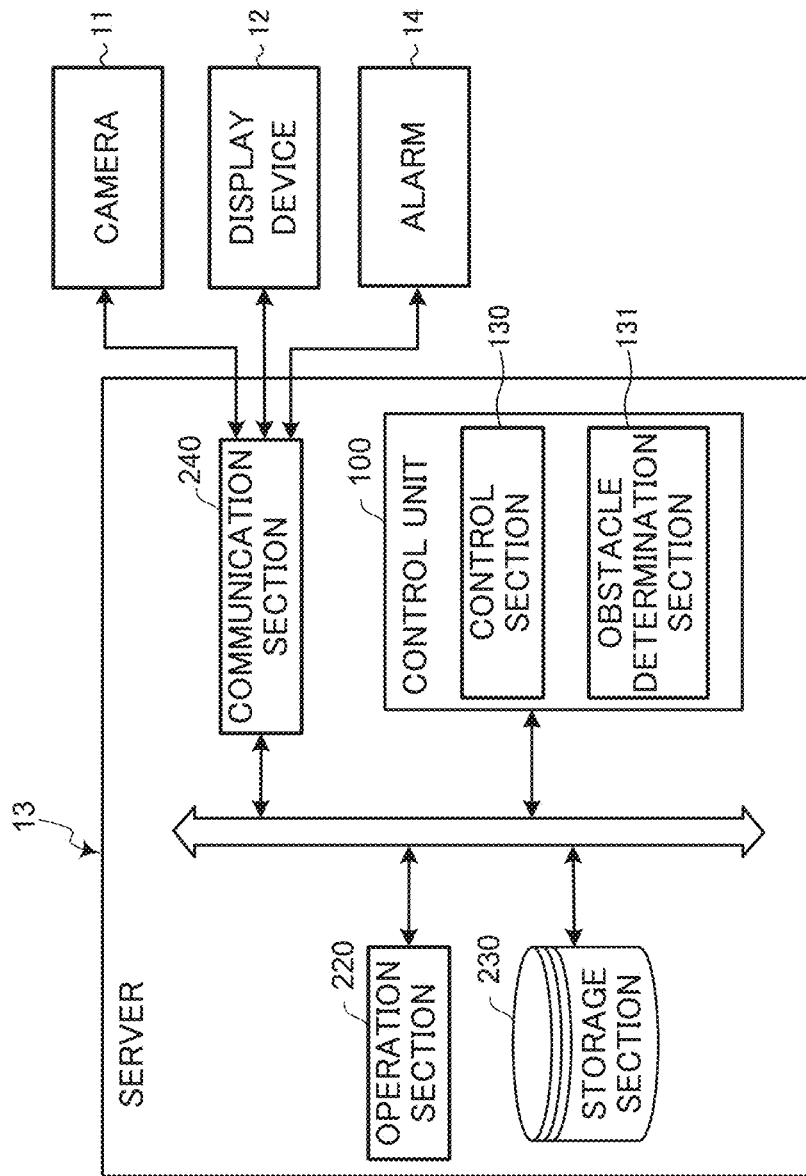


Fig.3

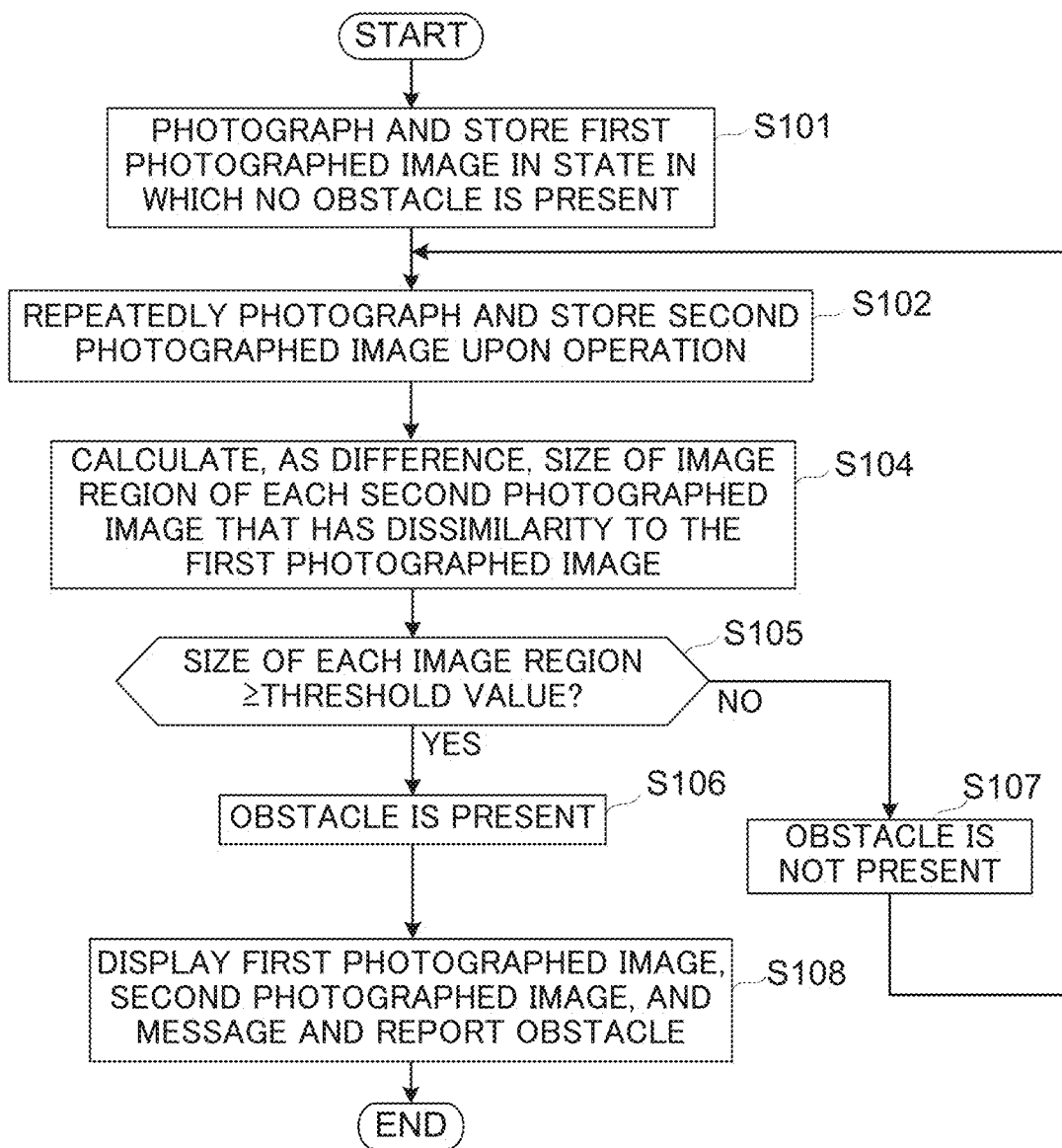


Fig.4A

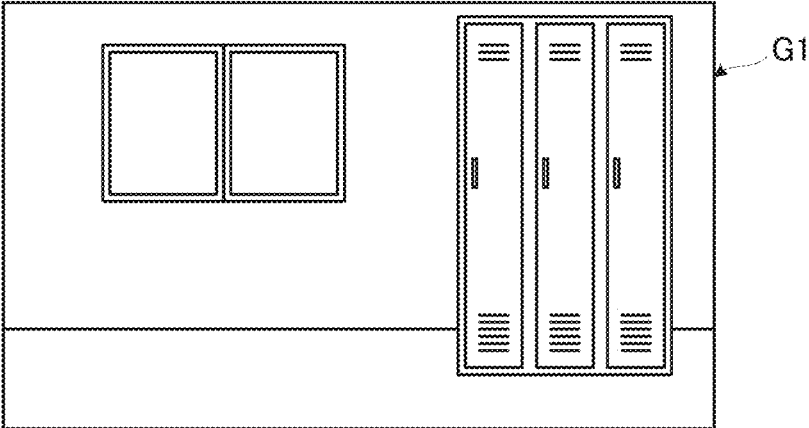


Fig.4B

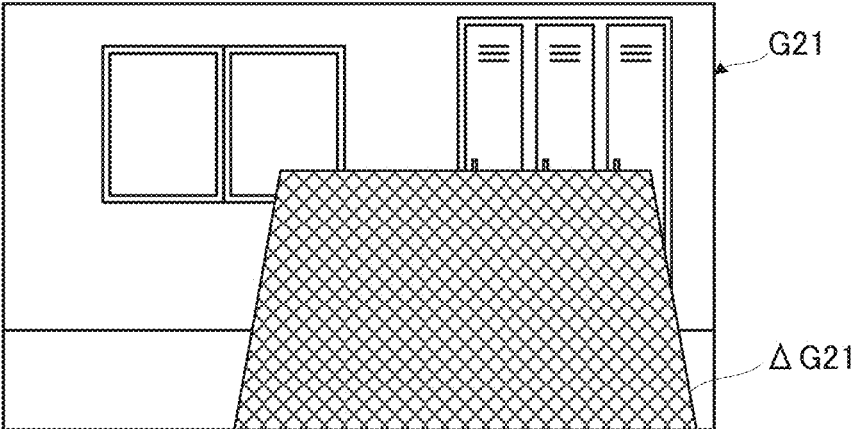


Fig.4C

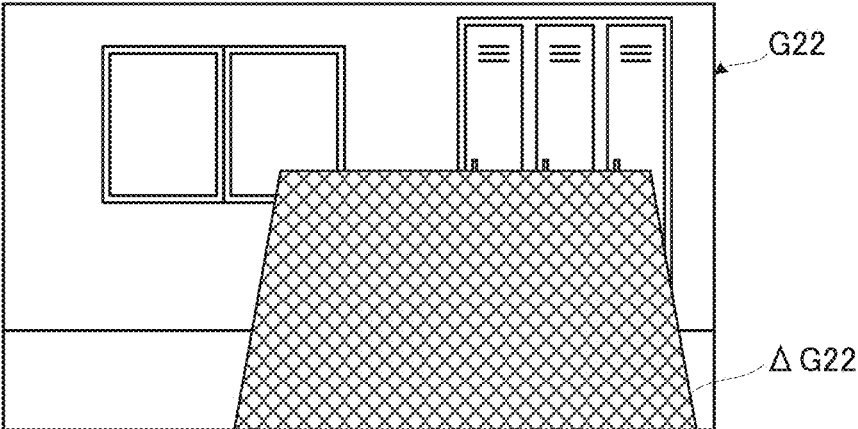


Fig.5A

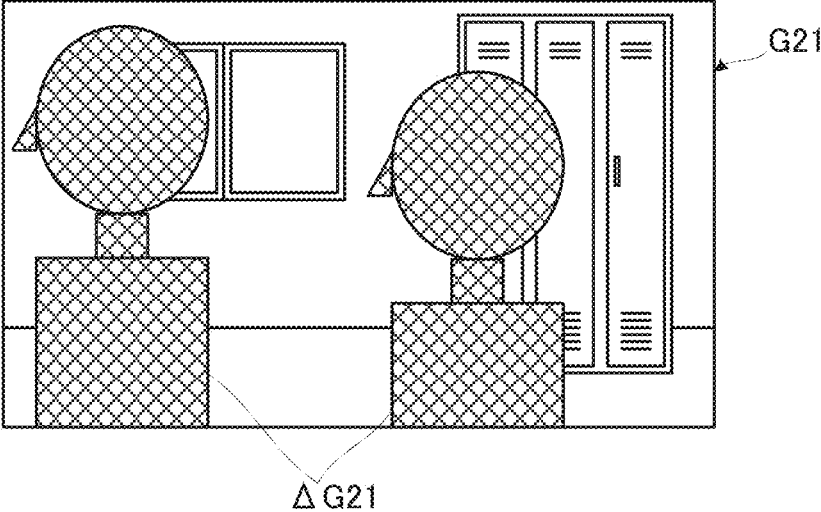
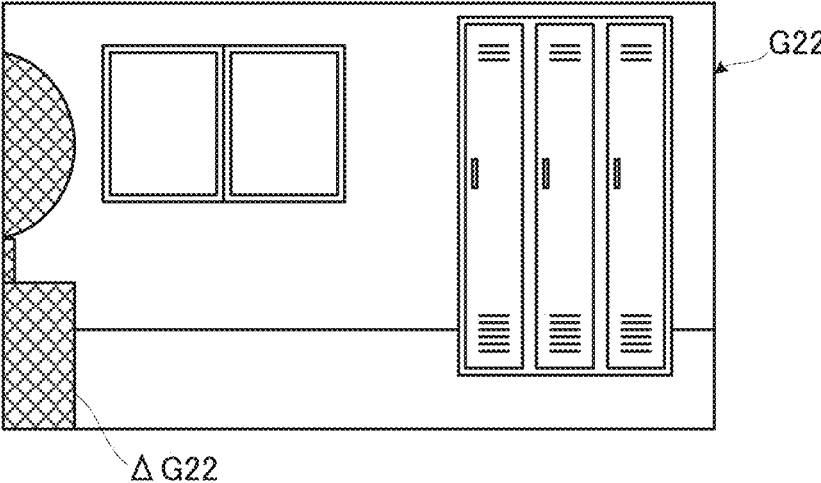


Fig.5B



MONITORING SYSTEM

INCORPORATION BY REFERENCE

This application claims priority to Japanese Patent Appli- 5
cation No. 2018-043318 filed on Mar. 9, 2018, the entire
contents of which are incorporated by reference herein.

BACKGROUND

The present disclosure relates to a monitoring system and
more specifically to a technology for detecting an obstacle
placed in a region photographed by a camera.

There is a technology of reliably photographing an object,
as a target to be monitored, by a camera. For example, with
a technology using an object tracking method, in a case
where the object has moved to an outside of a photographing
range, object detection processing is stopped, a direction in
which the object has moved is calculated based on move-
ment information of the object, and the object is photo-
graphed by another camera located in a direction in which
the object is oriented. Consequently, even in a case where
the object has moved to the outside of the photographing
range, the object can more accurately be photographed by
the camera and an image obtained by the photographing is
projected on a monitor, thereby permitting check of an
intruding object on the monitor.

SUMMARY

A technology obtained by further improving the technol-
ogy described above will be suggested as one aspect of the
present disclosure.

A monitoring system according to one aspect of the
present disclosure includes a camera, a storage section, and
a control unit. The camera photographs an object. The
storage section stores a first photographed image photo-
graphed by the camera and a second photographed image
photographed by the camera at a same photographing place
of a photographing place of the first photographed image
after the photographing of the first photographed image. The
control unit includes a processor and, through execution of
a control program by the processor, functions as an obstacle
determination section and a control section. The obstacle
determination section calculates a difference between the
first photographed image and the second photographed
image and determines, based on the difference, whether or
not an obstacle is present in a photographing range of the
camera. The control section performs, upon determination
by the obstacle determination section that the obstacle is
present, processing of reporting results of the determination.

An information processing apparatus according to one
aspect of the present disclosure includes a storage section
and a control unit. The storage section stores a first photo-
graphed image photographed by a camera photographing an
object and a second photographed image photographed by
the camera at a same place as a place of the first photo-
graphed image after the photographing of the first photo-
graphed image. The control unit includes a processor and,
through execution of a control program by the processor,
functions as: an obstacle determination section and a control
section. The obstacle determination section calculating a
difference between the first photographed image and the
second photographed image, and determines, based on the
difference, whether or not an obstacle is present in a photo-
graphing range of the camera, and the control section

performs, upon determination by the obstacle determination
section that the obstacle is present, processing of reporting
results of the determination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic configuration diagram illustrating a
monitoring system according to one embodiment of the
present disclosure.

FIG. 2 is a block diagram illustrating main sections of a
server.

FIG. 3 is a flowchart illustrating procedures of processing
of determining whether or not an obstacle is present in a
photographing range of a camera.

FIG. 4A is a diagram illustrating a first photographed
image photographed by the camera in a state in which no
obstacle is present.

FIGS. 4B and 4C are diagrams respectively illustrating
two second photographed images photographed at a prede-
termined interval by the camera in a state in which an
obstacle is present.

FIGS. 5A and 5B are diagrams respectively illustrating
two photographed images photographed at a predetermined
interval by the camera during passage of a person.

DETAILED DESCRIPTION

Hereinafter, a monitoring system according to one
embodiment of the present disclosure will be described with
reference to the drawings.

FIG. 1 is a schematic configuration diagram of a moni-
toring system according to one embodiment of the present
disclosure. The monitoring system 10 according to one
embodiment of the present disclosure includes at least one
camera 11, a display device 12, a server 13, and an alarm 14.
Note that this embodiment will be described, referring to, as
an example, a case where a plurality of, that is, four cameras
11 are present.

The plurality of cameras 11 are respectively installed at
positions which permit photographing of moving images
and still images all over a room 200.

The display device 12 receives, via the server 13, photo-
graphed images respectively transmitted from the cameras
11 and displays the photographed images. For example, the
same number of display devices 12 as a number of cameras
11 are included, the photographed images respectively
obtained by the cameras 11 are displayed at the separate
display devices 12, or a screen of the single display device
12 is divided into a plurality of display regions to display the
images in the respective display regions. Note that the
display device 12 is one example of a display section in the
scope of the claims.

FIG. 2 is a block diagram illustrating main sections of the
server 13. The server 13 includes: a control unit 100, an
operation section 220, a storage section 230, and a commu-
nication section 240. Note that the server 13 is one example
of an information processing apparatus in the scope of the
claims. The operation section 220 is an input device such as
a mouse or a keyboard. The storage section 230 is a storage
device such as an HDD or a flash memory.

The communication section 240 is a communication
interface including a communication module such as a LAN
chip. The communication section 240 is connected in a
manner such as to be capable of data transmission and
reception between each camera 11 and the display device 12
via a LAN or a network of the Internet. For example, the
photographed images respectively transmitted from the

cameras **11** are received at the communication section **240** and stored into the storage section **230**. Moreover, these photographed images are transmitted from the communication section **240** to the display device **12** by a control section **130** to be described later on.

The control unit **100** is composed of: a processor, a RAM, a ROM, and a dedicated hardware circuit. The processor is, for example, a central processing unit (CPU), an application specific integrated circuit (ASIC), or a micro processing unit (MPU). The control unit **100** functions as the control section **130** and an obstacle determination section **131** as a result of operation performed by the aforementioned processor in accordance with a control program stored in the storage section **230**. Note that, however, the aforementioned control section **130** and obstacle determination section **131** may each be formed by a hardware circuit without depending on the operation performed in accordance with the control program by the control unit **100**.

The control section **130** is in charge of overall operation control of the server **13**. Each of the aforementioned cameras **11** is connected to the server **13**, and the control section **130** controls operation of each camera **11**. The control section **130** also controls operation of the alarm **14**.

The obstacle determination section **131** calculates a difference between (i) a first photographed image photographed by the single camera **11** and (ii) a second photographed image photographed by the camera **11** (the same camera **11**) at a same photographing place but at a period which differs from and comes after a period of the photographing of the first photographed image, and based on this difference, determines whether or not an obstacle is present in a photographing range of the camera **11**. Note that the obstacle determination section **131** performs this determination independently for each of the photographed images respectively photographed by the cameras **11**. Upon determination by the obstacle determination section **131** that the obstacle is present, the control section **130** performs processing of reporting results of this determination.

Next, procedures of processing of determining an obstacle in the photographing range of the camera **11** by the server **13** will be described with reference to a flowchart illustrated in FIG. 3, etc.

First, the control section **130** of the server **13** independently causes each of the cameras **11** to photograph a photographable region. A first photographed image **G1** photographed by each camera **11** is transmitted from each camera **11** to the server **13**. FIG. 4A illustrates an example of the first photographed image **G1** provided by one of the plurality of cameras **11**. In the server **13**, the first photographed image **G1** is received at the communication section **240** and each first photographed image **G1** is stored into the storage section **230** on an individual camera **11** basis (S101).

In a case where each camera **11** photographs a still image, the first photographed image **G1** is photographed upon reception of a photographing instruction from the control section **130** by the camera **11**. In a case where each camera **11** photographs a moving image, the camera **11** extracts, as a still image from consecutively photographed moving images, photographing contents at a time point at which the photographing instruction has been received from the control section **130**, and the extracted image is provided as the first photographed image **G1**. Each of the first photographed images **G1** respectively photographed by the cameras **11** is stored as an original image into the storage section **230**.

Then the control section **130** independently causes each of the cameras **11** to photograph, at the same photographing place as that of the first photographed image **G1**, the second

photographed image photographed at the period which comes after the photographing of the first photographed image. The second photographed image is transmitted from each camera **11** to the server **13**. In the server **13**, the second photographed image is received at the communication section **240** and each second photographed image is stored into the storage section **230** on an individual camera **11** basis (S102).

Note that the control section **130** independently causes each camera **11** to repeatedly photograph the second photographed image every predefined cycle (for example, every ten minutes). The second photographed images are respectively transmitted from the cameras **11** to the server **13**. Upon every storage of the new second photographed image into the storage section **230**, the control section **130** erases the oldest second photographed image. Therefore, the second photographed images are sequentially stored into the storage section **230** of the server **13** on an individual camera **11** basis. Then the control section **130** sequentially erases the oldest second photographed image to store a predetermined number (at least two or more and the predefined number is "2" in this embodiment) of the second photographed images in the storage section **230**.

For example, the two second photographed images **G21** and **G22** photographed in the aforementioned cycle by the given camera **11** and stored into the storage section **230** are those illustrated in FIGS. 4B and 4C. Note that the second photographed image **G22** is an image photographed after the second photographed image **G21** was photographed. The obstacle determination section **131** extracts, from the second photographed image **G21**, an image region $\Delta G21$ of the second photographed image **G21**, the image region $\Delta G21$ being a region having dissimilarity to the first photographed image **G1**, calculates a size of this image region $\Delta G21$ as a difference between the first photographed image **G1** and the second photographed image **G21**, further extracts, from the second photographed image **G22**, an image region $\Delta G22$ of the second photographed image **G22**, the image region $\Delta G22$ being another region having dissimilarity to the first photographed image **G1**, and calculates a size of this image region $\Delta G22$ as a difference between the first photographed image **G1** and the second photographed image **G22** (S104). Then the obstacle determination section **131** determines whether or not each of the sizes of the image regions $\Delta G21$ and $\Delta G22$ is equal to or greater than a preset threshold value (S105). At this point, in a case where each of the sizes of the image regions $\Delta G21$ and $\Delta G22$ is equal to or greater than the threshold value (YES in S105), the obstacle determination section **131** determines that an obstacle is present (S106).

Specifically, the obstacle determination section **131** compares the first photographed image **G1**, photographed by the camera **11** when no obstacle is present, with each of the second photographed images **G21** and **G22** photographed during monitoring performed by the camera **11** after the photographing of the first photographed image **G1**. At this point, upon arrangement of the obstacle in the photographing range of the camera **11** during the monitoring performed by the camera **11**, the obstacle is included in each of the second photographed images **G21** and **G22**, so that the obstacle determination section **131** extracts, from the respective second photographed images **G21** and **G22**, the image regions $\Delta G21$ and $\Delta G22$ not viewed in the first photographed image **G1**, and when both of the image regions $\Delta G21$ and $\Delta G22$ are large, determines that the obstacle is present considering the image regions $\Delta G21$ and $\Delta G22$ as obstacle regions.

More specifically, the obstacle determination section **131** sequentially selects each pixel from all pixels forming the first photographed image **G1** and also sequentially selects, as a contrast target, pixels in the second photographed image **G21** (or **G22**) located at the same position as that of the pixels selected in the first photographed image **G1**. Then upon every selection of the pixels from the first photographed image **G1** and the second photographed image **G21** (or **G22**) in the manner described above, the obstacle determination section **131** compares pixel values of the respective selected pixels. Further, when the difference between the pixel values is equal to or greater than a defined level, that is, when the pixel values of the both selected pixels clearly differ from each other, the obstacle determination section **131** counts a number of pixels whose pixel values differ as described above. The obstacle determination section **131** performs the selection, comparison, and counting of the pixels only for all the pixels forming the first photographed image **G1** and the second photographed image **G21** (or **G22**) (may be performed only for the pixels in a predetermined partial region in the first photographed image **G1** and the second photographed image **G21** (or **G22**)).

Consequently, the obstacle determination section **131** calculates a pixel count **C21** (or **C22**) as the one which indicates the size of the image region $\Delta G21$ (or $\Delta G22$) not viewed in the first photographed image **G1**. That is, the obstacle determination section **131** calculates both the pixel count **G21** indicating the size of the image region $\Delta G21$ and the pixel count **G22** indicating the size of the image region $\Delta G22$. Then in a case where both of the pixel counts **C21** and **C22** are equal to or greater than a preset specified value **S** (for example, the pixel count occupying 10% of all the pixel counts of the first photographed image **G1** and the second photographed image **G21** (or **G22**)), the obstacle determination section **131** assumes that the size is equal to or greater than the threshold value and determines that the obstacle is present, and in a case where either of the pixel counts **C21** and **C22** is less than the aforementioned specified value **S**, the obstacle determination section **131** assumes that the aforementioned size is less than the threshold value and determines that no obstacle is present.

For example, in a case where at least one of the two second photographed images **G21** and **G22** becomes substantially equal to the first photographed image **G1** illustrated in FIG. 4A, the obstacle determination section **131** determines that at least one of the sizes of the image regions $\Delta G21$ and $\Delta G22$ is less than the threshold value ("No" in **S105**) and determines that no obstacle is present (**S107**). In this case, the processing from **S102** is repeated thereafter.

For example, in a case where the first photographed image **G1** is as illustrated in FIG. 4A and when people have passed through the photographing range of the camera **11**, the second photographed image **G21** (see FIG. 5A) and the second photographed image **G22** (see FIG. 5B) photographed at a predetermined time interval have different ways of person projection as illustrated in FIGS. 5A and 5B. At this point, the obstacle determination section **131** extracts an image indicating the person in the second photographed image **G21** or **G22** as the image region $\Delta G21$ or $\Delta G22$ (**S104**). At this point, the sizes of the image region $\Delta G21$ and the image region $\Delta G22$ differ from each other, and thus the obstacle determination section **131** may determine that the size of the image region $\Delta G21$ or $\Delta G22$ of only either one of the second photographed images **G21** and **G22** is equal to or greater than the threshold value while the size of another one of the image regions $\Delta G21$ and $\Delta G22$ is less than the threshold value (No in **S105**). At this point, the obstacle

determination section **131** determines that no obstacle is present (**S107**). That is, this person is not determined as the obstacle.

As described above, in a case where either of the sizes of the image regions $\Delta G21$ and $\Delta G22$ of the second photographed images **G21** and **G22** photographed at the predetermined time interval has become less than the threshold value, the obstacle determination section **131** assumes that a person or the like has crossed the photographing range of the camera **11** and determines that no obstacle is present.

Note that in a case where either of the sizes of the image regions $\Delta G21$ and $\Delta G22$ of the respective second photographed images **G21** and **G22** is less than the threshold value, the obstacle determination section **131** may determine that no obstacle is present only when the size of the image region $\Delta G22$ for the second photographed image which is included in the second photographed images **G21** and **G22** and which is photographed at later time, that is, the second photographed image **G22** in this embodiment is less than the aforementioned threshold value, and the obstacle determination section **131** may determine that the obstacle is present in cases other than the aforementioned case.

Moreover, upon determination by the obstacle determination section **131** that the obstacle is present (**S106**), the control section **130** transmits, to the display device **12** via the communication section **240**, identification information indicating which of the plurality of cameras **11** has photographed the photographed image determined to have the obstacle, the first photographed image **G1** and the second photographed image **G21** or **G22** photographed by the aforementioned camera **11**, a message indicating that the obstacle is present, etc., and the control section **130** causes the display device **12** to display the identification information, the first photographed image **G1** and the second photographed image **G21** or **G22**, the message, etc. or causes the alarm **14** to sound (**S108**). The control section **130** causes the display device **12** to display the identification information of the camera **11**, the first photographed image **G1** and the second photographed image **G21** or **G22**, the message, etc. The control section **130** also causes the alarm **14** to generate alarm sound.

At this point, listening to the aforementioned alarm sound or viewing the screen of the display device **12**, a manager or the like can judge, based on the identification information of the camera **11**, the camera **11** determined to have the obstacle. The manager or the like can, on his or her own, compare the first photographed image **G1** with the second photographed image **G21** or compare the first photographed image **G1** with the second photographed image **G22** to thereby judge whether or not the obstacle is present and confirm whether or not the obstacle is placed in the photographing range of the camera **11**. Then upon confirmation that the obstacle is placed, the manager or the like can perform operation of, for example, removing the obstacle and changing a direction of the camera **11**.

Note that, in a case where the direction of the camera **11** has been changed, it is possible to perform the processing starting with **S101** to thereby update the first photographed image **G1** as the original image and then determine whether or not the obstacle is present.

As described above, in this embodiment, the obstacle determination section **131** determines whether or not the obstacle is present in the photographing range of the camera **11**, and upon determination that the obstacle is present, the display device **12** is caused to display the identification information of the camera **11**, the first photographed image and the second photographed image, the message, etc., so

that the manager or the like can view the screen of the display device **12** to confirm that the obstacle is placed in the photographing range of the camera **11** or can remove the obstacle or change the direction of the camera **11**.

Here, in a case where the obstacle is placed in the photographing region of the camera, a person or an object is hidden by the obstacle and the person or the object to be originally photographed can no longer be photographed. However, a technology described in the background art above can cause another camera to photograph an object as long as a moving direction of the object can be calculated, but when the object can no longer be detected due to the presence of the obstacle, a direction in which the object has moved can no longer be calculated, so that the object cannot be photographed by the camera located in the direction in which the object is present. As described above, no measures for the object placed in the photographing region of the camera has been taken so far, and even when a state arises in which photographing of a person or an object to be monitored cannot be photographed, this state has been left in some cases.

On the contrary, in this embodiment, whether or not the obstacle is present in the photographing range of the camera is determined, and in a case where the obstacle is present, it is possible to report that the obstacle is present

Note that in the embodiment described above, the obstacle determination section **131** not only uses the two second photographed images **G21** and **G22** to determine whether or not the obstacle is present, and upon storage of a new second photographed image into the storage section **230**, the control section **130** may perform, on an individual camera **11** basis, processing of sequentially erasing the old second photographed image so as to store only the single second photographed image into the storage section **230**, and the obstacle determination section **131** may use only the single second photographed image to extract the image region not viewed in the first photographed image **G1** from the aforementioned second photographed image, may determine that the obstacle is present in a case where the size of the extracted image region is equal to or greater than the threshold value, and may determine that no obstacle is present in a case where the size of the extracted image region is less than the threshold value.

Moreover, the obstacle determination section **131** not only performs not only the processing of determining, by use of the two second photographed images **G21** and **G22**, whether or not the obstacle is present, and the control section **130** may perform, on an individual camera **11** basis upon the storage of the second photographed image into the storage section **230**, processing of sequentially erasing the old second photographed image so as to store a predefined number (greater than two) of second photographed images into the storage section **230**, and the obstacle determination section **131** may use the aforementioned number of second photographed images to extract each image region not viewed in the first photographed image **G1** for each of the aforementioned number of second photographed images different from the first photographed image **G1**, may determine that the obstacle is present in a case where the sizes of all the extracted image regions are equal to or greater than the threshold value, and may determine that no obstacle is present in a case where the size of at least one of the extracted image regions is less than the threshold value.

Further, in a case where the size of at least one of the image regions extracted in the manner described above is less than the threshold value, the obstacle determination section **131** may determine that no obstacle is present only

when the size of the aforementioned image region for the second photographed image photographed at the later time is less than the threshold value described above, and may determine that the obstacle is present in other cases.

Moreover, the configuration and the processing illustrated in the embodiment described above with reference to FIGS. **1** to **5** just refer to one embodiment of the present disclosure, and thus the present disclosure is not limited in any way to these configuration and processing.

While the present disclosure has been described in detail with reference to the embodiments thereof, it would be apparent to those skilled in the art the various changes and modifications may be made therein within the scope defined by the appended claims.

What is claimed is:

1. A monitoring system comprising:

a camera photographing an object;
a storage section storing a first photographed image photographed by the camera and a second photographed image photographed by the camera at a same photographing place of a photographing place of the first photographed image after the photographing of the first photographed image; and

a control unit including a processor and, through execution of a control program by the processor, functioning as:

an obstacle determination section calculating a difference between the first photographed image and the second photographed image and determining, based on the difference, whether or not an obstacle is present in a photographing range of the camera, and

a control section performing, upon determination by the obstacle determination section that the obstacle is present, processing of reporting results of the determination,

wherein the obstacle determination section extracts an image region of the second photographed image, the image region being a region having dissimilarity to the first photographed image, and calculates a size of the extracted image region as the difference, and

the obstacle determination section sequentially selects each pixel from all pixels forming the first photographed image, also sequentially selects, as a contrast target, a pixel of the second photographed image located at a same position as a position of the pixel selected in the first photographed image, upon the every selection, determines whether or not pixel values of the respective pixels selected from the first and second photographed images differ from each other, counts a number of the pixels determined to be different, determines that the size of the image region is equal to or greater than a threshold value in a case where the counted number of the pixels is equal to or greater than a preset specified value, and determines that the size of the image region is less than the threshold value in a case where the counted number of the pixels is less than the specified value.

2. The monitoring system according to claim **1**, further comprising

an information processing apparatus being connected to the camera, wherein
the information processing apparatus includes the control unit.

3. The monitoring system according to claim **1**, further comprising

a display section, wherein

upon the determination by the obstacle determination section that the obstacle is present, the control section causes the display section to display the first photographed image and the second photographed image.

4. A monitoring system comprising:
 - a camera photographing an object;
 - a storage section storing a first photographed image photographed by the camera and a second photographed image photographed by the camera at a same photographing place of a photographing place of the first photographed image after the photographing of the first photographed image; and
 - a control unit including a processor and, through execution of a control program by the processor, functioning as:
 - an obstacle determination section calculating a difference between the first photographed image and the second photographed image and determining, based on the difference, whether or not an obstacle is present in a photographing range of the camera, and
 - a control section performing, upon determination by the obstacle determination section that the obstacle is present, processing of reporting results of the determination,
 wherein the obstacle determination section extracts an image region of the second photographed image, the image region being a region having dissimilarity to the first photographed image, and calculates a size of the extracted image region as the difference, and
 - the obstacle determination section sequentially selects each pixel for a predefined partial region in the first photographed image, sequentially selects, as the contrast target, the pixel of the second photographed image located at the same position as the position of the pixel selected in the first photographed image, upon the every selection, determines whether or not the pixel values of the respective pixels selected from the first and second photographed images differ from each other, counts the number of the pixels determined to be different, determines that the size of the image region is equal to or greater than the threshold value in a case where the counted number of the pixels is equal to or greater than the specified value, and determines that the

size of the image region is less than the threshold value in a case where the counted number of the pixels is less than the specified value.

5. A monitoring system comprising:
 - a camera photographing an object;
 - a storage section storing a first photographed image photographed by the camera and a second photographed image photographed by the camera at a same photographing place of a photographing place of the first photographed image after the photographing of the first photographed image; and
 - a control unit including a processor and, through execution of a control program by the processor, functioning as:
 - an obstacle determination section calculating a difference between the first photographed image and the second photographed image and determining, based on the difference, whether or not an obstacle is present in a photographing range of the camera, and
 - a control section performing, upon determination by the obstacle determination section that the obstacle is present, processing of reporting results of the determination,
 wherein after the photographing of the first photographed image, the photographing of the second photographed image by the camera is performed at least twice at a time interval and each of the second photographed images is stored into the storage section, and
 - the obstacle determination section calculates a difference between the first photographed image and each of the second photographed images, determines that the obstacle is present in a case where the difference for each of the second photographed images is equal to or greater than the threshold value, and determines that the obstacle is not present in a case where the difference for either of the second photographed images is less than the threshold value.
6. The monitoring system according to claim 5, wherein in a case where the difference for either of the second photographed images is less than the threshold value, the obstacle determination section determines that the obstacle is not present only when the difference for the second photographed image photographed at later time is less than the threshold value.

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